

Behavioral and Psychological Issues In Long Duration Head-Down Bed Rest

Kimberly A. Seaton, Ph.D.; Kendra Bowie, M.A.; Walter A. Sipes, Ph.D.

University of Texas Medical Branch at Galveston (Seaton); Wyle Laboratories, Inc. (Bowie); and NASA Johnson Space Center, Houston (Sipes)

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Corresponding Author:

Kimberly A. Seaton, Ph.D.

Wyle Laboratories

1290 Hercules Boulevard

Houston, TX 77058

Telephone: 281-212-1234

Fax: 281-212-1370

Email: kseaton@wylehou.com

ABSTRACT

INTRODUCTION: Behavioral health services, similar to those offered to the U.S. astronauts who complete six-month missions on board the International Space Station, were provided to 13 long-duration head-down bed rest participants. Issues in psychological screening, selection, and support are discussed as they relate to other isolated and confined environments. **METHODS:** Psychological services offered to participants are described, and challenges in subject selection and retention are discussed. **RESULTS:** Psychological support and training provided to both subjects and study personnel have successfully improved the wellbeing of study participants. **DISCUSSION:** Behavioral health services are indispensable to long-duration head-down tilt bed rest studies.

KEY WORDS: Space flight, emotional support

INTRODUCTION

The NASA Flight Analogs Project (FAP) was conducted like a space mission; therefore much of the terminology for space missions is used in conducting the bed rest study. Behavioral health services, similar to those offered to the crewmembers that complete six-month missions on board the International Space Station, were provided to the flight analogs bed rest participants.

Refer to Meck, et al. (14) for description of the protocol and general conditions of the studies, and the use of long duration head-down bed rest as a model for space flight. Bed rest and test protocols were reviewed and approved by the Johnson Space Center Committee for the Protection of Human Subjects, the UTMB Institutional Review Board, and UTMB General Clinical Research Center Science Advisory Committee. Subjects received verbal and written explanations of the bed rest and test protocols before providing written informed consent.

The FAP psychological services team from Wyle Laboratories' Space Medicine Group's Behavioral Health and Performance Section provided psychological services for 13 long duration head-down bed rest participants in a study conducted at the Flight Analogs Research Unit (FARU) at the University of Texas Medical Branch in Galveston, Texas. Project deliverables and direction were provided by NASA's Chief of Operational Psychology. In preparation, a psychologist consultant was contracted to provide a review of relevant bed rest literature, focusing particularly on psychological issues. The consultant also conducted site visits at bed rest study facilities around the United States

to glean knowledge about the general behavioral management practices used in these facilities, and provided training and summary reports to the FAP psychological services team (Shirley Ellis, Ph.D, ABPP, written communication, May 2005).

Psychological Screening and Selection

After passing the initial medical screening (NASA-modified Air Force Class III Flight Physical), all subject candidates were evaluated by a licensed clinical psychologist to ensure that they possessed the psychological and emotional stability and resilience necessary to complete all aspects of the study. Screening methods used standardized psychological inventories and International Classification of Diseases criteria for psychiatric disorders. During psychological screening, candidates completed four hours of standardized personality testing, questionnaires about mood states and substance abuse, questionnaires developed specifically for long-duration bed rest studies, and a 1.5 hour clinical interview with the psychologist.

The purpose of the psychological screening was twofold. First, candidates were evaluated for the presence of current psychiatric or psychological disorders and/or undesirable traits (e.g., predisposition for mental illness, psychopathological characteristics, and difficulties with interpersonal relationships) that could jeopardize their successful completion of the study. Second, candidates were assessed in terms of positive qualities (e.g., stress tolerance, maturity, emotional stability, ability to get along with others) that would make them well suited for participation in a long-duration head-down bed rest research study. Several studies corroborated the general observation

that head-down bed rest can have a negative impact on mood and behavior, hence the need to select individuals who are psychologically stable and least likely to decompensate under psychological stress (7, 8, 9, 10). The psychological stress referred to is multifaceted, but is primarily derived from physical discomfort coupled with isolation from their usual social support system and the continuous presence of other people (19).

The psychological screening process was refined as more was learned about the problematic and undesirable behaviors or traits of study participants. For example, although a highly driven and organized individual might be expected to translate into a composed and compliant bed rest participant, our experience revealed that people with these traits may find it difficult to cope with the inevitable schedule changes and inconsistencies associated with these types of studies. One modification to the psychological screening process was the addition of behavioral observations during unstructured time and group activities during screening and pre-admission orientation. These additional activities were implemented beginning with the eighth subject and allowed the team to observe participants interacting with one another as they might on a daily basis when they are less concerned about making a positive impression.

Additional screening involved identification of pairs of individuals likely to be compatible roommates. It is well understood that conflict often arises due to the mix of individual characteristics and personalities within a group (13). Moser and Weiss found in their study of head-down bed rest that interpersonal relationships between two subjects

sharing a room were of primary importance in terms of adjusting to the lack of personal space and privacy (19). Behavioral contagion was observed in the ways participants used their time or interacted on the FARU, reinforcing the importance of selecting dyads that are well suited in personality and other characteristics. Although compatibility of roommates is desirable, roommate assignments often had to be made on the basis of admission dates due to the limited number of rooms in the bed rest facility.

Candidate Motivation

When asked about their motivation to participate in bed rest studies, the candidates gave a variety of responses, ranging from “wanting to help NASA and the astronauts” and “to help the space industry and do what I can for the betterment of mankind” to needing the financial compensation and “getting paid for lying in bed.” Others viewed it as an exercise in self discipline. Although participants with a variety of self-expressed motivations successfully completed the study, those with an interest in the space program appeared to maintain a greater interest in the scientific aspects of the research. Several candidates who were self-described “professional test subjects” presented for screening. These candidates often had unstable employment histories and low achievement motivation. Due to a limited number of eligible candidates, these individuals were not excluded. However, if motivation is solely financial, subjects could be at increased risk for premature termination if they were to feel they had received enough money. Additionally, these participants may be more likely to drop out when they encounter difficulty because they are aware of other opportunities available as a paid test subject. Regardless of their initial motivation, the goal of the psychological

services team was to impart upon the subject a sense of how their participation was contributing directly to NASA's goals of space exploration. A visit or phone call with a former or current astronaut, when possible, was helpful for maintaining participants' motivation and interest in the science.

Based on all testing, interviews, and observations, candidates were given an overall rating by the psychologists for best fit using the categories described below. These ratings were then provided to the study coordinators and principal investigator as recommendations to be considered for a final selection decision.

A: Qualified with no reservations. These candidates are considered most likely to successfully complete the study and interact well with staff, roommates, and other subjects. They can be expected to meet the specific operational and psychosocial demands of long-duration bed rest protocols.

B: Qualified with reservations. These candidates can be expected to need some additional psychological monitoring and intervention. For example, they may have a history of prior substance abuse that could indicate inadequate coping strategies, or an unstable occupational history that could indicate difficulty following through with uncomfortable obligations.

C: Qualified with strong reservations. These candidates are at higher risk for premature termination of study participation. They are likely to require additional psychological

monitoring and additional services to emphasize/reinforce pre-admission skills training. For example, these candidates may have poor interpersonal skills, a history of domestic discord that could indicate poor conflict resolution skills, or characteristics that make them more likely to decompensate under stressful conditions.

D: Disqualified. These candidates are not considered psychologically qualified for participation in a head-down bed rest study (i.e., meets exclusionary criterion such as history of mental illness or currently meeting criteria for diagnosis of mental illness, use of nicotine products within six months of study, inability to cooperate, or inability to provide fully informed consent due to language or comprehension barriers).

Due to the limited number of medically qualified applicants, some subjects who were psychologically qualified with strong reservations were admitted into the study. Although not ideal candidates, several of these subjects completed the study and contributed good data. In these instances, the psychological services team closely monitored the subjects, provided additional training for the staff about how to best work with these individuals, and made recommendations to project management when reminders were needed to extinguish undesirable behavior.

Pre-Admission Orientation Activities

International Space Station crewmembers receive preflight training about conflict resolution, multicultural issues, and stress management to help them recognize and address problems as they arise during their long-duration missions. Similarly, psychoeducational training was provided before and during the bed rest studies. This training was intended to give participants additional tools to draw upon in dealing with inevitable challenges.

Beginning with subject eight, participants received additional pre-admission assistance, including brief training on time/schedule management skills, stress/pain management strategies, and communication/interpersonal skills. The training time served -the dual purpose of teaching tools for coping and also facilitating the development of rapport and trust between the participants and psychological services team members. Before the implementation of additional training, some participants tended to view the unfamiliar psychological services team members as “just another person asking me how I’m doing” rather than as resources for support. Another benefit of the additional training and orientation was that it allowed participants informal time together as a group, visiting the bed rest facility. This additional orientation and preparation appeared to foster a cohesive team of participants, who supported and advocated for each other throughout the study. Participants who did not receive the additional orientation and preparation were not observed to develop cohesiveness as a group, or to be as supportive of each other. In contrast, participants who received the additional orientation and preparation maintained frequent contact with each other, communicating

via instant messaging and personal cellular phones, meeting regularly to watch movies and play games in the common area, and advocating for one another to staff. The pre-admission orientation materials that were developed for training the participants on coping strategies are described below.

Time Management

Before the study, subjects were encouraged to think about educational or personal goals they could explore while participating in the study, and they were provided specific training about developing goals and tracking their progress. Even so, some participants did not engage in meaningful, productive activities during the study. Planned and goal-oriented activities can help relieve monotony, whereas an excess of unstructured time may increase feelings of boredom, irritability, and excessive rumination. Participants must also be prepared to cope with occasional unexpected changes in their testing schedule. The purpose of instruction on time management was to teach them about the realities of participating in the study as compared to their fantasies of how they would spend their time. Experiences and recommendations from previous bed rest study participants were shared with new participants.

Stress/Pain Management

Being placed in a head-down bed rest position for an extended period of time results in physical and emotional discomfort. Additionally, the participants are removed from their "normal" lifestyle, support group, and environment. Because they encounter unusual stressors, it is helpful to learn additional coping strategies. Before being placed in the

stressful situation, participants were encouraged to learn and practice a menu of stress and pain management skills such as diaphragmatic breathing, progressive muscle relaxation, and guided imagery techniques. Web site addresses and CDs with these and other stress and pain management strategies were made available to the participants.

Communication Skills

Some participants had difficulty expressing their needs and preferences in a direct, assertive manner to the appropriate person. Some participants' communication skills appeared to regress during the study, possibly as a result of the nature of study participation (i.e., being in a dependent and helpless position, requiring assistance with basic tasks of daily living). Basic communication skills were taught to the participants on how to express their needs, wants, concerns, and discomfort.

Roommate Policies

The bed rest facility was designed with two beds per room. Little research has been done specifically about the advantages and disadvantages associated with double-occupancy rooms versus private rooms or open wards for long-duration bed rest subjects. Some of the literature points to double- or multiple-occupancy rooms as possibly helping to decrease isolation and distress if the subjects are also provided with opportunities to be away from their roommates (19).

Though the many studies that have addressed issues of isolation and confinement are relevant, participation in long-duration head-down bed rest research does not result in solitude so much as the continuous presence of others with little possibility of being separated from them (19). Some participants complained about the lack of privacy and personal space, and the lack of consideration shown by some roommates. However, Weiss and Moser suggest that roommates may ultimately benefit one another by allowing for emotional comparison and providing reassurance that the situation is stressful for everyone, although subjects may also have a need at times to compensate for this forced socialization and limited privacy by withdrawing (19).

Based on experiences with the first seven subjects, specific roommate policies were described in writing and clearly communicated to participants during the pre-admission orientation process. One lesson learned early on was that the bed nearest the exterior window is the preferred position in the room. Not only does it offer more natural light, it is also further from the noises, distractions, and bright lights from the hallway and nurses' station. Additionally, during the head-down bed rest phase of the study, the bed closest to the door must be moved (disrupting that subject) to allow the "window bed" subject to enter or exit the room. Therefore, a policy was devised that at the mid-way point in the study, the room positions would be switched in an attempt to be most fair to both subjects. Additional policies included: telephones were to be disconnected and cell phones turned off and placed in a drawer at night, window blinds and doors were to be kept open, and lights were required to be on during the day. Each subject was advised to allow his/her roommate approximately two hours per day of private time in

the room (for personal phone calls, etc.) and privacy during massage/relaxation time. Participants were encouraged to be especially considerate of their roommates after lights out, notifying staff when they need assistance by waving at the camera before using the loud call button. During the pre-admission skills training, suggestions from previous participants regarding roommates were shared with new participants, including “be considerate with musical instruments or loud devices, bring large headphones that cover your ears, start getting ready for bed an hour before lights out, and leave the room when your roommate is receiving a massage, has visitors or phone calls, or needs to have a bowel movement.”

Staff Training

The psychological services team provided training for study personnel to address personality and behavioral management challenges inherent in conducting long-duration head-down bed rest research studies. Training included education about the common physical and psychological effects of long-duration head-down bed rest, psychological principles to facilitate cooperation and increase motivation in participants, and specific examples of communication styles and recommended responses for appropriate and inappropriate comments from participants. Subject monitors also were provided additional training regarding interpersonal communication skills and maintaining professional boundaries. Because subject monitors had the most direct continuous contact with the participants due to the nature of their job responsibilities, training was essential to ensure that they were adequately prepared to deal with the wide variety of subject interactions that they could encounter.

Bed Rest Activities

Although the purpose and focus of most bed rest research has been on developing medical countermeasures, designing countermeasures for dealing with interpersonal and psychological issues is likely to become an increasingly important objective of future space simulation studies (6). Throughout their time in the study, participants were offered a variety of options for psychological services, including individual visits to each participant at a minimum of once per week. The psychological services team consisted of a psychiatrist, a psychologist, and a master's-level psychological support scientist. Within the first two days of arrival at the bed rest facility, a member of the psychological services team visited each participant and reviewed the purpose and structure of psychological services during the study and the limits of confidentiality in this setting. In general, utilization of psychological services tended to increase during the head-down tilt phase of the study, and accommodations were made be available by pager, telephone, and email when team members were not available in person. Additional services and materials provided by the psychological services team during study participation are described below.

Family Support Guidebooks

Family Support Guidebooks were provided to each participant upon admission to the study. Participants were invited to distribute them to their significant family members and friends. Guidebooks contained information on physical and psychological effects the participant may experience, the purpose and importance of the study, how

significant others can be supportive, general hospital visitation policies, suggestions for the care and discipline of the participants' children, and contact information for the psychological services team. Particularly with female participants, childcare has been an issue of paramount importance. Problems related to childcare that were observed in our participants included differing approaches to discipline with their designated caregiver, misunderstandings regarding the person responsible for various tasks such as pick-ups from school, inadequate contact with the children, and hospital visits that were cancelled, too brief, or infrequent. Psychological interventions were provided on an as-needed basis to participants and family members to offer support, to assist with role clarification and communication, and to educate family members on the importance of their involvement, regular visits and telephone contact, and emotional support.

Psychoeducational Groups

All psychological training elements were accompanied by group instruction sessions. The group sessions included education and demonstrations on a variety of relaxation skills and breathing techniques that the participants could use during bed rest. The participants also received instruction on common responses to isolation and confinement, coping strategies, communication techniques to minimize aggression or stress, and strategies for integrating personal activities within the experimental constraints and schedule. Specific strategies for coping with unappealing food, roommate discord, and motivation problems were discussed as needed. Additional group sessions focused on the development of the participants' personal goals and assistance with goal setting and time management. The psychological services team

followed up with the participants periodically during the study about the progress they had made toward their goals and accomplishments.

Clinical Assessment and Monitoring

Changes in mood and behavior were observed in two of the earlier subjects. Although the participants verbally denied any problems, they appeared to experience increased levels of anxiety and distress. These changes in mood were suspected to be related to individual situational stressors rather than as a result of participation in the study.

During data analysis, the subjective observations of increased distress were corroborated by increased salivary cortisol levels and subject self-report on written instruments administered by the immunology team, the Positive and Negative Affect Scale (PANAS) and Perceived Stress Scale (PSS) (3). Therefore, biweekly written clinical assessments of the participants' levels of anxiety and depression were implemented by the psychological services team in an effort to detect any difficulties as early as possible to facilitate a prompt response and prevent significant deterioration of mood.

Countering Boredom and Decreased Motivation

Some researchers have observed that during the halfway to third-quarter milestones of studies involving extended isolation and confinement, boredom and withdrawal appear to increase and motivation appears to decrease (1, 2, 19). Additionally, inactivity and withdrawal are reported to be indicative of poor abilities to cope with a stressful situation, whereas affiliative tendencies and engaging in preferred activities appear to be

indicative of positive responses to stress (19). Accordingly, we found that psychological support was especially important during this phase, to reemphasize the contributions the participants were making to the space program, and to provide additional motivating events and activities. Kanas (12) reports that countermeasures used by Russian psychologists and flight surgeons to deal with the signs and symptoms of asthenia in space include reorganizing work schedules to allow for more leisure-time activities; scheduling difficult job tasks in the morning rather than right before bedtime; limiting nonessential contact with Mission Control personnel; encouraging physical activities to enhance normal physiological responses; sending up surprise presents and favorite foods on resupply spacecraft to provide novelty and stimulation; and improving morale by increasing audiovisual contact with friends, relatives, and famous personalities on Earth. Although some of these countermeasures were not possible due to the constraints of the bed rest studies, participants were encouraged to increase contact with friends, relatives, and other subjects. Additionally, holidays, birthdays, and milestones such as Day 45 were recognized and celebrated, and motivational events such as a personal visit from an astronaut or flight surgeon and a telephone call from an astronaut on the International Space Station appeared to boost subject morale. We also provided motivational wake-up music (similar to the wake ups provided to International Space Station and Shuttle crewmembers) for the 6:00 am wake-up process. Internet access also provided a wide array of entertainment and educational opportunities and allowed participants to connect with the outside world.

Feelings of Helplessness and Loss of Control

Some subjects reported significant feelings of helplessness due to the degree to which they had to rely on others to accomplish simple daily tasks, and some engaged in a variety of strategies to increase their perception of control. Even among the crews of real and simulated space missions, tension has been identified between the crew and Mission Control over imposed regulations of crew activities and task overloads (4, 5, 11, 16). These observations underscore the fundamental issue of autonomy. Although the research protocol ultimately dictates what the participants can and cannot do, it is preferable for participants to have choices when possible. Staff education was provided regarding the importance of offering choices when possible and respecting participants' decisions.

Group Dynamics

NASA has recognized the need to monitor group dynamics within the crew and between the crew and ground personnel and to develop strategies to counter dysfunctional patterns (15, 17). Isolated and confined environments often yield a high level of cohesion that comes about from shared experience that can become a maladaptive "us versus them" phenomenon resulting in generalized resistance to and mistrust of outsiders (15, 17). These types of dynamics have been observed to some degree with the bed rest subjects and emphasize the importance of trained personnel who are aware that these feelings are to be expected. Specialized trainings were implemented with staff to prepare them to recognize areas where their own personal motives might be interfering with their abilities to provide care or maintain good working relationships

with participants. Staff also received training about self-care and the importance of avoiding dual role relationships with study participants.

Importance of Entertainment and Group Activities

Between periods of intensive testing, participants had a great deal of unstructured time. Although the intensive testing periods were reportedly stressful due to the time-consuming and intrusive nature of the data collection, the “down time” could become equally stressful because it provided little distraction from the unpleasant aspects of being a long-duration head-down bed rest participant. A staff member, the Activities Coordinator, was dedicated to assisting the participants in obtaining movies, compact discs, games, and developing plans for participants’ entertainment, including birthday celebrations, group activities, and themed events such as “Monday Night Football.”

Family Problems

Family issues encountered during the study necessitated some special interventions. Problems included family members advising the participant to leave the study, family members disregarding hospital visitation rules or research protocol rules, death of family member, childcare provider problems, relationship problems, and health problems of friend or family member. Interventions included consultation with participants, offering family meetings in person or via telephone, assisting with problem solving, coordinating visits with hospital chaplains and local ministers, and reminders that participation was voluntary and leaving the study was always an option.

Roommate Discord

Examples of problems between roommates included disagreements about lighting or temperature in the room, practicing a musical instrument in the room, scheduling private time in the room, allowing privacy for family visits and phone calls, and teasing each other about performance on tests or about how difficult or painful the next test would be. Interventions included mediation between roommates, assisting the participants to negotiate and reach compromises, discouraging teasing, and providing “roommate etiquette rules” to participants during the pre-admission orientation.

Staff or Environment Concerns

Examples included annoyances with staff, food, and lighting; lack of privacy; inadequate time for showering and personal hygiene; and difficulty accessing resources such as hair stylist, on-line educational courses, and chaplain or minister. Interventions included providing encouragement to participants to communicate their concerns in a direct and assertive manner, assisting with communicating their concerns to staff, assisting with referrals to hospital pastoral care and local ministers, and making telephone contacts to local college admissions office.

Post-Bed Rest Activities

The goal of psychological services during the reconditioning period was to evaluate the psychological state of participants to counter possible after-effects. Services included interviews and questionnaires assessing anxiety and adaptation in the first days after standing up, and assessing how subjects coped with study participation overall.

To assist with reintegration to work, home, family, and their normal routine, a “Going Home Guidebook” was provided to each participant before discharge. The Guidebook included information regarding reconditioning and physical activities to resume with caution, dietary issues such as reintroducing caffeine and alcohol, and expectations about returning to home and family relationships.

During the reconditioning phase as the participants were preparing for discharge, they were asked to provide informal feedback about their overall thoughts about participating in the research study, any suggestions or recommendations for future study participants, and any comments that they would like to share. In general, participants expressed relief and eagerness to be leaving the hospital environment. Some verbalized mild trepidation about returning to “normal life again,” but no serious difficulties were reported. Feedback from previous participants was very helpful and assisted the psychological services team to modify its program to benefit future subjects.

Psychological services also were provided for unplanned study termination. A few participants were discharged earlier than anticipated, due to the hurricane evacuation or unrelated, non-serious medical reasons. Psychological services were offered at these times to address the participants’ feelings of disappointment and anxiety.

Team/Personnel Issues

In the best conducted projects, conflict can occur among or between groups of people. Effective communication is always a challenge; however, when the parties trying to communicate are using terms and acronyms specific to their own organizational culture, the difficulty is compounded. Because the development of a cohesive team was necessary for the success of this project, we endeavored to improve relationships by encouraging multidisciplinary collaboration and inter-team communication, and clear lines of communication and responsibility. Building a cohesive team was also an essential part of protecting staff from “splitting” and other types of manipulation by participants. We learned that participants, with a paucity of other things to focus on, can be surprisingly attentive and sensitive to the interpersonal dynamics among team members. The participants may overhear and react to any negative comments, inconsistencies, or disagreements, so it is important to mediate any disputes and to build a cohesive interdisciplinary team. The psychological services team provided education for all staff members about communication and conflict resolution skills and training in dealing with different types of personalities and the importance of maintaining professional boundaries. Topics such as transference, countertransference, and exploration of personal motives (e.g., the desire to be liked or appreciated) were discussed in light of how they could affect interactions with participants and other staff members. The trainings appeared to be successful in reducing the number of complaints expressed by both staff and participants regarding interpersonal communication problems. These trainings have been incorporated into the FAP Team Member Training Plan.

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REFERENCES

1. Betchel RB, Berning A. The third-quarter phenomenon: Do people experience discomfort after stress has passed? In: Harrison, A, Clearwater YA, and Kay CP, eds. *From Antarctica to Outer Space: Life in Isolation and Confinement*. New-York: Springer-Verlag 1991: 261-65.
2. Cazes C, Rosnet E, Bachelard C, et al. Group dynamics during the EXEMSI isolation study. *Experimental Campaign for the European Manned Space Infrastructure*. *Adv Space Biol Med* 1996; 5: 245-62.
3. Crucian BE, Stowe RP, Mehta SK, et al. Assessment of immune status, latent viral reactivation and stress during long duration bed rest as an analog for space flight. *Aviat Space Environ Med In Review*.
4. Gushin VI, Kolintchenko VA, Efimov VA, Davies C. Psychological evaluation and support during EXEMSI. *Adv Space Biol Med* 1996. 5: 283-96.
5. Gushin VI, Zaprisa TB, Kolintchenko, et al. Content analysis of the crew communication with external communicants under prolonged isolation. *Aviat Space Environ Med* 1997; 12: 1093-8.
6. Holland AW, Curtis K. Operational psychology countermeasures during Lunar-Mars life support test project. *Life Support Biosph Sci* 1998; 5:445-52.
7. Ishizaki Y, Ishizaki T, Fukuoka H, et al. Changes in mood status and neurotic levels during a 20-day bed rest. *Acta Astronaut* 2002; 50(7): 453-9.
8. Ishizaki Y, Fukuoka H, Ishizaki T, et al. Evaluation of psychological effects due to bed rest. *J Gravit Physiol* 2000; 7(2): 183-4.

9. Ishizaki Y, Fukuoka H, Ishizaki T, et al. Psychological stress induced by 20 days bed rest. *J Gravit Physiol* 1997; 4(1): S95-8.
10. Ishizaki Y, Fukuoka H, Katsura T, et al. Psychological effects of bed rest in young healthy subjects. *Acta Physiol Scand Suppl* 1994; 616: 83-7.
11. Kanas N, Salnitsky V, Grund E, et al. Interpersonal and cultural issues involving crews and ground personnel during shuttle/Mir Space Missions. *Aviat Space Environ Med* 2000; 9 Suppl. 71: A11-6.
12. Kanas N, Salnitsky V, Gushin V, et al. Asthenia -- Does it exist in space? *Psychosom Med* 2001; 63(6):874-80.
13. Kubis JF. Isolation, conflict, and group dynamics in long duration spaceflight. *Acta Astronaut* 1972; 17:45-72.
14. Meck JV, Dreyer S, Warren L. Multisystem responses to long-duration bed rest: Overview. *Aviat Space Environ Med In Review*.
15. Palinkas L. Psychosocial issues in long-term space flight: Overview. *Gravit Space Biol Bull* 2001 June; 14(20):25-33.
16. Sandal FM, Bergan T, Warncke M, et al. Psychological reactions during polar expeditions and isolation in hyperbaric chambers. *Aviat Space Environ Med* 1996; 67: 227-34.
17. Sandal GM. Psychosocial issues in space: Future challenges. *Gravit Space Biol Bull* 2001 June; 14(2):47-54.
18. Suedfeld P, Steel GD. The environmental psychology of capsule habitats. *Annu Rev Psychol* 2000; 51: 227-53.

19. Weiss K, Moser G. Interpersonal relationships in isolation and confinement: Long-term bed rest in head-down tilt position. *Acta Astronaut* 1998 Aug-Sep; 43(3-6): 235-48.